ENERGY $AVER$

"... For Business and Industry".

VOLUME TWO / NO. 3

TURN ON THE SAVINGS WITH A TIME CLOCK

The Facts...

Wise building owners and operators in Alberta can save on energy costs without sacrificing a comfortable environment for occupants by turning off air-handling systems during unoccupied hours.

Heating, ventilating and air-conditioning (HVAC) systems use substantial quantities of energy to heat, cool, humidify and move large volumes of air. Much of this energy use is unnecessary when buildings are unoccupied. Reducing the amount of conditioned air leaving the building means that less fresh air must be drawn in to replace it. Using time clocks to limit the operating hours of HVAC systems to the minimum required, significantly reduces energy use and cost.

Based on energy audits by the Alberta Energy Bus audit program, the average potential natural gas saving by using time clocks would be $1250 per year. The average potential electrical saving would be $500 per year. Time clocks are particularly suited for buildings with simple HVAC systems where the annual energy bill is less than $50 000. Larger buildings usually require more complex means of control.

Most buildings in Alberta were designed, and are operated, such that interior conditions are maintained constantly, 24 hours per day. Building ventilation systems are seldom turned off.

However, most buildings are unoccupied during part of each day. Many offices, for example, are occupied 40 to 50 hours per week or about 25 per cent of the time. This means that energy cost savings may be possible for up to 75 per cent of the time. Special purpose facilities such as theatres and banquet halls are occupied even less of the time.

Manual control of HVAC systems is easily done but is less reliable than automatic time clocks. For example, air exhaust systems for washrooms and locker rooms can be equipped with manual on and off switches. Although these systems can be turned off by building staff during unoccupied hours, they are often left running continuously.

Interval timers are mechanically- or electrically-driven timing devices that can also control exhaust fan operation. Available in timing ranges from about one minute to 12 hours, they must be manually set before the fans will come on. When the selected time cycle has run out, the switch automatically shuts off the fan. Use of these devices is limited to specific types of applications.

Automatic time clocks are reliable, inexpensive and have a wide range of potential uses. Choosing the right type of automatic time clock is an important step in achieving energy cost savings. Different types of clocks can be purchased: 24-hour, seven-day, 365-day and day/night time clocks. Depending on the features, clocks cost from $50 to $600.

Time clock.

Twenty-four hour time clocks switch loads on and off automatically at the same time each day. Electronic time clocks are now available which allow for 24-hour programming and can initiate change as frequently as every five minutes. These features allow for more precise control and therefore greater energy savings. Most electronic time clocks have a back-up system in case of power failures. When the power returns the batteries are recharged, or, if the system is mechanical, the spring is automatically rewound.

Seven-day time clocks can be programmed for different schedules each day of the week. Some can be set to skip selected days. Manual override features allow the user to temporarily bypass the clock action, without changing the program, if the building is used after hours.

Similarly, 365-day time clocks can be programmed for different schedules, every day of the year. They can also provide "set and forget" convenience by allowing for holiday programming and daylight saving time and leap year correction.

Day/night time clocks turn on at sunset and off at sunrise. This clock automatically adjusts the setting each day in accordance with seasonal changes of sunset and sunrise. They are usually located in parking lots to control the lighting but can be adapted for other applications.

If operation of the air-handling system is necessary for heating, it can be controlled to operate only when the thermostat calls for heat rather than operating continuously. Outside air dampers should be closed during these periods so that only return air is provided when the fan comes on to meet the demand for heat. Control of both the fans and the outside air dampers can be achieved with a simple time clock.

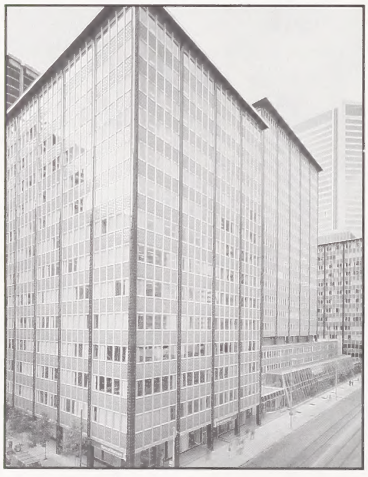
Shutting off building ventilation when it is not needed can significantly reduce energy costs. The use of an automatic time clock is a simple way to achieve this cost saving.

The Application...

Elveden Centre, Calgary's first high-rise complex, built in 1961, consists of three towers linked by a windowed plaza. The combined floor area of the three towers is about 663 500 square feet (61 600 square metres). At the request of Brian Couronne, assistant property manager of Campeau Pacific Corporation (building owners), an energy audit of the complex was conducted by staff of the Alberta Energy Bus audit program.

The audit team predicted that turning off some of the ventilation systems when the towers were unoccupied and reducing ventilation rates to minimum requirements for health and comfort would save $59 100 per year in natural gas costs and $14 200 per year in electrical costs. Prior to the audit, the building's ventilation systems operated at full capacity, all day, every day.

Following the audit, Couronne and his staff wanted to demonstrate that expected savings were achievable with minimal (if any) discomfort to the building's tenants. Maintenance staff manually turned off the individual ventilation systems and exhaust fans during evening and weekend hours. They made sure that fan systems started early enough to have the building ventilation back to normal fresh air requirements as tenants started arriving.



Elveden Centre, Calgary.

After implementing this energy-saving measure, Couronne became aware that manual switching can be unreliable and has a high labor cost component. He investigated the use of automatic time clocks to reliably achieve the same savings. Relatively inexpensive time clocks now shut down the building's ventilation systems during unoccupied periods. "Simple timers are all that are required at this stage," said Couronne. Couronne has found that by turning off the air-handling system during non-use periods, the temperature in Elveden Centre decreases during winter heating months, resulting in less heat loss. During summer months, the reduced cooling load associated with the reduced ventilation allows the air-conditioning system to shut down earlier.

The Bottom Line...

Installing an automatic time clock to turn fans off during unoccupied hours is an easy and practical step in reducing energy costs without sacrificing user comfort. The payback period will depend on the installed cost of the time clock and the cost saving that it achieves. To calculate the payback period in months, divide the installed cost by the annual savings, multiplied by 12 months of the year.

Building owners and operators can use Figure 1 to determine the order of magnitude of their existing costs and potential savings. However, care should be exercised in determining fan capacities in larger fan systems as there are many variables associated with automatic controls.

To determine present energy use, select the hours of operation on the horizontal axis that correspond to the operating hours of your ventilation system. Then, read up to the appropriate mixed-air temperature of either 50°F (10°C) or 55°F (13°C) and across to the left to obtain your present energy use expressed in gigajoules of natural gas per cubic feet per minute of ventilation air per year (GJ/cfm/yr.).

Repeat these steps to find the energy use that would result from shutting off your air-handling system during unoccupied hours. Hours of operation will vary depending on the type of facility you operate. The following formula can then be used to calculate the savings:

Annual Savings = (present energy

use – proposed energy use) × cfm × $/GJ

The example below illustrates the potential savings through turning off air-handling systems during unoccupied periods. The example is based on a system consisting of large supply, return and exhaust fans that circulate and replace some of the air. The make-up air which replaces air discharged from the building is mixed with the return air to achieve a selected temperature, known as the mixed-air temperature.

Frequently, systems have more than one exhaust fan per system and, ideally, all exhaust fans could be turned off, allowing the supply fan to be turned off as well.

EXAMPLE

Mixed-air temperature	55°F (13°C)	Fan volume	1000 cfm
Exhaust air temperature	70°F (21°C)	Natural gas rate	$2.30/GJ
Hours of operation	168 hrs./wk.	Proposed hours of operation	50 hrs./wk.

For this example, the present energy use (gigajoules per cubic feet per minute per year) would be 0.178 GJ/cfm/yr (obtained from Figure 1 graph). For the new hours of operation, the expected energy use would be 0.051 GJ/cfm/yr.

The potential savings can be calculated as follows:

Annual natural gas cost savings:
= (0.178 – 0.051 [GJ/cfm/yr.]) × 1000 cfm = × $2.30/GJ
= $292 per year

Electrical cost savings = 0.746 kW/hp × hp × cost × hours/wk. × wks./yr.

Where:		
	Fan motor horsepower	1 hp
	Electrical rate (cost)	$0.035/kW.h
	Reduced hours of operation	118 hours (168-50)
	Weeks of operation	52 weeks

Annual electrical cost savings:
= 0.746 kW/hp × 1 hp × $0.035/kW.h × 118 hrs./wk. × 52 wk./yr.
= $160 per year

Total annual energy cost savings:

natural gas	$292
electrical	$160
Total	$452 per year

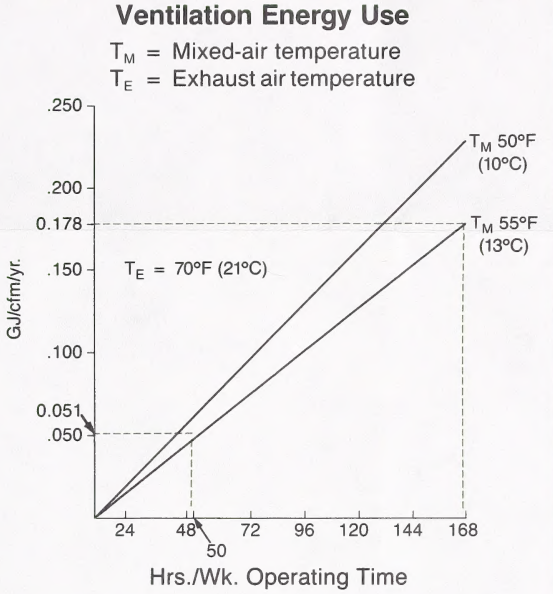
Installing a regular time clock to control this system will cost about $250. About $100 can be added to this cost when installing an electronic type. Based on these costs, the payback period can be calculated as follows:

$$\text{Payback period} = \frac{\text{installation cost}}{\text{annual savings}} \times 12 \text{ months}$$

Payback (regular)
$\frac{\$250}{\$452} \times 12 = 6.5$ months

Payback (electronic)
$\frac{\$350}{\$452} \times 12 = 9.2$ months

FIGURE 1



SECTOR REVIEW

Energy Use in Large Office Buildings

Energy use varies widely depending on the type of building and the activities in the building. The extent of variation of energy use has become evident following Energy Bus audits of almost every type of facility in Alberta.

An energy audit determines how energy is being used and how much it costs in each area. Energy conservation measures are then identified which may result in energy cost savings. On average, the Energy Bus has identified a potential reduction in energy cost of about 20 per cent.

Staff of Alberta's Energy Bus audit program has conducted energy audits of 27 large office buildings in Alberta with a floor area greater than 250 000 square feet (23 230 square metres). In the large office building sector, the potential for energy savings identified during the audits was 19 per cent of the energy used.

Office buildings require significant amounts of energy to provide a comfortable working environment for tenants and to operate equipment. Figure 2 shows the proportion of natural gas and electrical use and their associated costs for large office complexes. Natural gas represents 47 per cent of total energy use but only 17 per cent of energy cost. The reason for the difference in energy use and cost is that natural gas is the least expensive energy source in Alberta. In the large office building sector, electricity is about four times as expensive as an equivalent unit of natural gas.

An energy use breakdown for both natural gas and electricity for this sector is shown in Figure 3. Energy used for ventilation is a major component of total energy use. Heating, ventilating and air-conditioning (HVAC) systems require natural gas to heat the air, and, in many instances, to humidify it. Electricity powers fan motors used to move conditioned air throughout the building and to provide cooling during summer months.

Turning ventilation systems off during unoccupied hours is a simple, low-cost measure that results in sub-

stantial savings in natural gas and electrical costs.

Alberta's Energy Bus audit program has identified good potential for ventilation savings in the large office building sector – $390 600 per year for natural gas (52 per cent) and $246 200 per year for electricity (12 per cent) for a total savings of $636 800 in the 27 audited buildings. This represents an average of 23 per cent of the total potential savings identified, as shown in Figure 4.

FIGURE 2 **Energy Use and Cost**
Large Office Buildings
(>250 000 sq. ft.) (>23 230 m²)

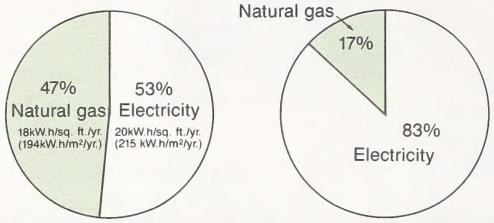


FIGURE 3 **Energy Use in Large Office Buildings**

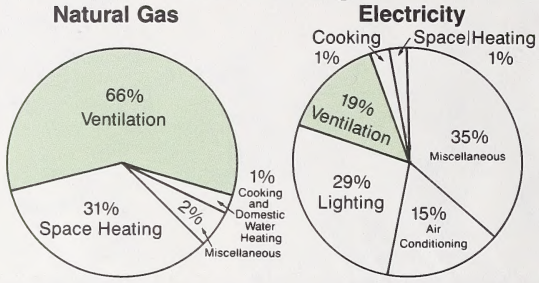
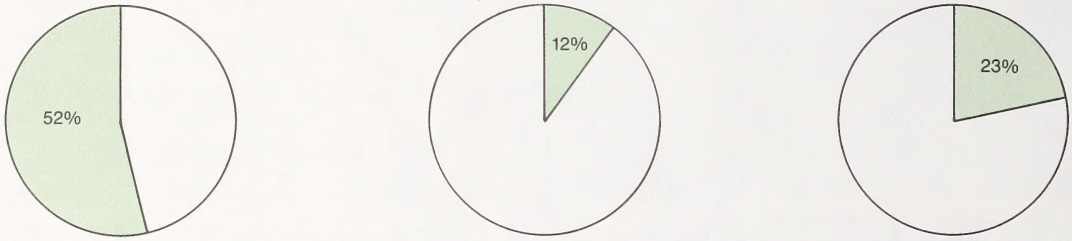
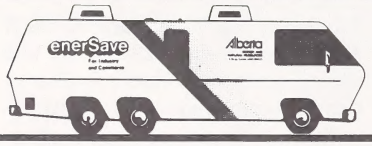


FIGURE 4 **Cost Saving Potential Through Ventilation Reduction During Unoccupied Periods**



FOR MORE INFORMATION

The article Turn On the Savings With A Time Clock was researched by Jim Riddell and the Sector Review was completed by Les Sladen. For detailed information on energy cost saving calculations and the energy audit database, contact the industrial section of the Energy Efficiency Branch: Phone 427-5200 (collect).



ENERGY $AVER$

Energy $aver$ is a series of fact sheets about energy conservation measures that have wide application in Alberta. Each issue highlights a different technology and its successful use in the province. The Sector Review summarizes energy use patterns of different facilities that have used the Alberta Energy Bus audit service. Comments, questions and suggestions are welcome.

Write or phone (collect) to be placed on the mailing list. You may also obtain Energy $aver$ back issues or arrange for an Energy Bus audit (conducted at no charge).

Alberta Department of Energy
Energy Efficiency Branch
2nd Floor, 10010 - 106 Street
Edmonton, Alberta T5J 3L8
Telephone: 427-5200

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